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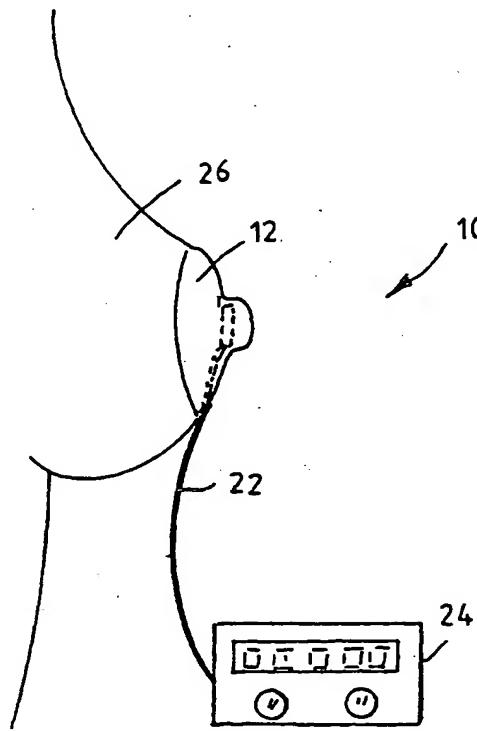
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(54) Title: APPARATUS FOR DETERMINING THE AMOUNT OF MILK BREAST-FED TO A BABY

(57) Abstract: An apparatus for determining the amount of human milk supplied to a feeding baby during a breast-feeding session is disclosed and claimed. The apparatus comprises a feeding cap (12) adapted to be mounted on the nipple region of a breast (26) of a mother. The cap (12) defines an outlet (20) through which milk passes to the feeding baby. A flowmeter (14) is provided to measure the amount of milk passing through the outlet (20).



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WO 01/54488 A1

APPARATUS FOR DETERMINING THE AMOUNT OF MILK  
BREAST-FED TO A BABY

INTRODUCTION AND BACKGROUND

THIS invention relates to baby care products and methods and more particularly to apparatus to determine the volume of human milk breast-fed to a baby. The invention also relates to a flowmeter for use in other applications.

To determine the volume of milk consumed by a baby during breast-feeding sessions, it is known to weigh the baby before the session as well as during and immediately after the session. This is a cumbersome process and the scales required are rather sensitive and thus expensive.

OBJECT OF THE INVENTION

Accordingly it is an object of the present invention to provide apparatus and a method with which the amount of milk may be determined and with which the applicant believes the aforementioned disadvantages may at least be alleviated.

**SUMMARY OF THE INVENTION**

According to the invention there is provided apparatus for determining the amount of human milk supplied to a feeding baby during a breast-feeding session, the apparatus comprising:

- a feeding cap adapted to be mounted on the nipple region of a breast of a mother;
- the cap defining an outlet through which milk passes to the feeding baby; and
- a flowmeter to measure the amount of milk passing through the outlet.

The feeding cap may be dome-shaped and may be made of isoprene rubber or any other suitable material.

The flowmeter may comprise a body defining a passage which is in communication with the outlet. Electronic circuitry and/or sensors forming part of the flowmeter may be mounted and/or integrated on the body.

The sensors may be sensitive to one or more of the rate of flow; the

volume of flow; the temperature of the milk; and chemicals indicative of mastitis.

The flowmeter may be connectable via a data communication cable to display means. The display means may comprise a LED or liquid crystal display. Alternatively the display means may be adapted to print a graphical representation of data received from the flowmeter.

The display means may comprise a selection switch selectively to display the amount of milk, the temperature of the milk and an indication of the presence of said chemicals.

The invention also extends to a feeding cap connectable to or including a flowmeter; and a flowmeter for use in determining the amount of human milk supplied to a feeding baby.

Also included within the scope of the present invention is a method of determining the amount of human milk supplied to a feeding baby during a breast feeding session, the method comprising the steps of:

- providing a flowmeter between a breast of a mother and a mouth

- of the feeding baby;
- monitoring the amount of milk supplied; and
- displaying the amount of milk supplied.

#### BRIEF DESCRIPTION OF THE ACCOMPANYING DIAGRAMS

The invention will now further be described, by way of example only, with reference to the accompanying diagrams wherein:

figure 1 is a diagrammatic illustration of the apparatus according to the invention connected to the breast of a breast-feeding mother;

figure 2 is a sectional view through a feeding cap forming part of the apparatus and illustrating one possible location of the flowmeter;

figure 3 is a diagrammatic perspective view, partially broken away, of an assembly forming part of a flowmeter according to the invention;

figure 4 is a plan view of the assembly in figure 3;

figure 5 is a diagrammatic view from the rear of the assembly; and

figure 6 are two series of sectional views namely on line A in figure

4 in the top row and on line B in figure 4 in the bottom row.

#### DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Apparatus for measuring the volume of human milk breast-fed to a baby (not shown) is generally designated by the reference numeral 10 in figure 1.

The apparatus comprises a feeding cap or nipple shield 12 of isoprene rubber. As shown in figure 2, a flowmeter or sensor 14 is mounted in the cap 12. The flowmeter comprises a body 16 defining at least one passage 18 therethrough communicating with an outlet 20 defined by the cap.

Electronic circuitry and sensors forming part of the flowmeter are preferably mounted and/or integrated on the body 16. The circuitry is connectable via a data communication cable 22 to display means 24.

The sensors are sensitive to rate and/or volume of liquid flow through body 16. Sensors sensitive to the temperature of the milk and the presence of chemicals in the milk indicative of mastitis may also be

included. In some embodiments the feeding cap may be mounted in a feeding brassière.

In use, the feeding cap 12 is mounted on the breast 26 of a mother. The feeding baby (not shown) is allowed to feed through the feeding cap. The volume of milk taken in by the baby is measured by the flowmeter 14. The flowmeter may also measure the temperature of the milk and may also be sensitive to the presence of the aforementioned chemicals.

The volume and temperature of the milk are selectively displayed on the display 24. The display could also be manipulated to provide an indication of the presence of the aforementioned chemicals in the milk.

Thus, the apparatus according to the invention provides the mother in real time with an indication of the volume and temperature of milk taken in by the feeding baby. It would accordingly no longer be necessary to follow the cumbersome weighing process hereinbefore described.

Since the apparatus 10 also provides an indication of the presence of the aforementioned chemicals in the milk, early warning is provided to

the mother, so that preventative steps may be followed in time, to avoid the discomfort of mastitis.

An assembly forming part of another embodiment of a flowmeter for use in this application as well as any other suitable application is generally designated 30 in figures 3 to 6. The assembly includes a cylinder 32 having an inlet conduit 34 and an outlet conduit 36. Cylinder 32 defines an elongate chamber 38 which is square in transverse cross section. Inlet conduit 34 communicates with the chamber 38 in the cylinder via first and second spaced ports 40 and 42. Outlet conduit 36 also communicates with the chamber via spaced first and second ports 44 and 46. Ports 44 and 46 are longitudinally outwardly spaced from ports 40 and 42. A block shaped piston 48 is located in the chamber for reciprocating motion in the chamber.

The piston 48 defines peripheral slots 50 and 52 towards top and bottom regions thereof and in a region thereof overlapping with the inlet conduit 34.

Between the piston 48 and the aforementioned ports there is provided a rectangular, slidable seal 54.

The seal 54 includes top and bottom end flanges 56 and 58. The length of the seal between the two flanges 56 and 58 is shorter than the length of the chamber by the dimension of one of ports 44 and 46 in a longitudinal direction.

The seal is moveable in the chamber by the piston 48 between a first position shown in figure 5 and in the left hand diagrams in figure 6 and a second position shown in the right hand diagrams in figure 6. The seal defines first and second holes 60 and 62 longitudinally in line with inlet ports 40 and 42. The pitch between the holes being such that when the seal is in the first position, hole 62 is in register with inlet port 42, but inlet port 40 is covered by seal 54. When the seal is in the second position, hole 60 is in register with port 40, but hole 62 no longer is in register with port 42, so that the seal covers the latter port. Furthermore, due to the aforementioned difference in the length of the chamber and the seal, when the seal is in the first position, port 44 is open and port 46 closed. When the seal is in the second position, port 44 is closed and port 46 is open.

Referring now to figure 6, in use, with the seal 54 in the first position, inlet port 42 and outlet port 44 are open. The other ports are closed.

Due to suction applied by the baby via outlet conduit 36, milk from the breast enters chamber 38 via port 42. The piston 48 is caused to move upwardly and milk fills the chamber below piston 48. With piston 48 approaching the top of the chamber, it engages flange 56 of the seal and moves it upwardly as shown in the right hand illustrations in figure 6. The result is that the aforementioned ports 42 and 44 are closed by the seal 54 and that inlet port 40 is opened by registering hole 60 in the seal and outlet port 46 is also opened. Suction via outlet 36 causes the piston 48 to move downwardly and to displace the milk in the chamber through outlet 46 to the baby. At the same time milk from the breast enters the chamber above piston 48 via inlet 40. When the piston approaches the bottom of the chamber, it engages flange 58 of the seal to move the seal back to the aforementioned first position. As stated hereinbefore, in this position inlet 42 is opened by hole 62 and top outlet 44 is also opened, by the displaced seal. At the same time inlet 40 and outlet 46 are closed.

This procedure is repeated while suction is applied by the feeding baby. The number of oscillations of piston 38 is directly proportional to the volume of milk displaced from the breast via chamber 38 to the baby.

The flowmeter further includes means for counting the number of oscillations and for computing the volume of liquid displaced. The means for counting the oscillations may include a photo-optic arrangement (not shown) including a light transmitting device mounted on one side of cylinder 32 and a light detector on the other side of the cylinder. The number of times that the light beam emitted by the transmitting device is interrupted is proportional to the number of oscillations, which in turn is proportional to the volume displaced as hereinbefore described. The opto-electronic arrangement is connected to a controller for counting the number of interruptions and for computing the volume of milk displaced.

It will be appreciated that there are many variations in detail on the apparatus and method according to the invention, without departing from the scope and spirit of the appended claims.

**CLAIMS:**

1. Apparatus for determining the amount of human milk supplied to a feeding baby during a breast-feeding session, the apparatus including:
  - a feeding cap adapted to be mounted on the nipple region of a breast of a mother;
  - the cap defining an outlet through which milk passes to the feeding baby; and
  - a flowmeter to measure the amount of milk passing through the outlet.
2. An apparatus as claimed in claim 1 wherein the feeding cap is dome-shaped and made of isoprene rubber.
3. An apparatus as claimed in claim 1 or claim 2 wherein the flowmeter includes a body defining a passage which is in communication with the outlet and wherein electronic circuitry and/or sensors forming part of the flowmeter are mounted and/or integrated on the body.

4. An apparatus as claimed in claim 3 wherein the sensors are sensitive to at least one of the following: rate of flow, volume of milk, temperature of the milk, and chemicals indicative of mastitis.
5. An apparatus as claimed in any one of the preceding claims wherein the flowmeter is connectable via a data communication cable to display means.
6. An apparatus as claimed in claim 5 wherein the display means includes a selection switch manipulatable to cause the display means to display the volume of milk, the temperature of the milk and an indication of the presence of said chemicals.
7. A method of determining the amount of human milk supplied to a feeding baby during a breast feeding session, the method comprising the steps of:
  - providing a flowmeter between a breast of a mother and a mouth of the feeding baby;
  - monitoring the amount of milk supplied; and
  - displaying the amount of milk supplied.

8. A feeding cap adapted to be mounted on a nipple region of a breast of a mother, the cap defining an outlet through which milk may pass to a sucking baby, the cap including or being connectable to a flowmeter to measure the amount of milk passing through the outlet.
9. A meter for metering the volume of a liquid flowing from a source to a destination, the meter including:
  - an elongate cylinder defining a chamber;
  - a piston mounted for reciprocating motion in the chamber;
  - first and second inlet ports to the chamber defined towards respective end regions of the cylinder; the inlet ports being connectable to the source;
  - first and second outlet ports from the chamber defined towards respective end regions of the cylinder; the outlet ports being connectable to the destination;
  - a seal moveable in the chamber under influence of the reciprocating piston between a first position wherein the first outlet port and the second inlet port are open and a second position wherein the first inlet port and the second outlet port are open

- thereby alternately and repeatedly filling the chamber with the liquid on one and another side of the piston via the second and first inlet ports and displacing the liquid from the chamber alternately and repeatedly via the first and second outlet ports; and
- means for counting the number of oscillations of the piston.

10. An apparatus for determining the amount of human milk supplied to a feeding baby during a breast-feeding session substantially as herein described with reference to the accompanying diagrams.

11. A method of determining the amount of human milk supplied to a feeding baby during a breast-feeding session substantially as herein described with reference to the accompanying diagrams.

12. A feeding cap substantially as herein described with reference to the accompanying diagrams.

13. A flowmeter substantially as herein described with reference to the accompanying diagrams.

1/3

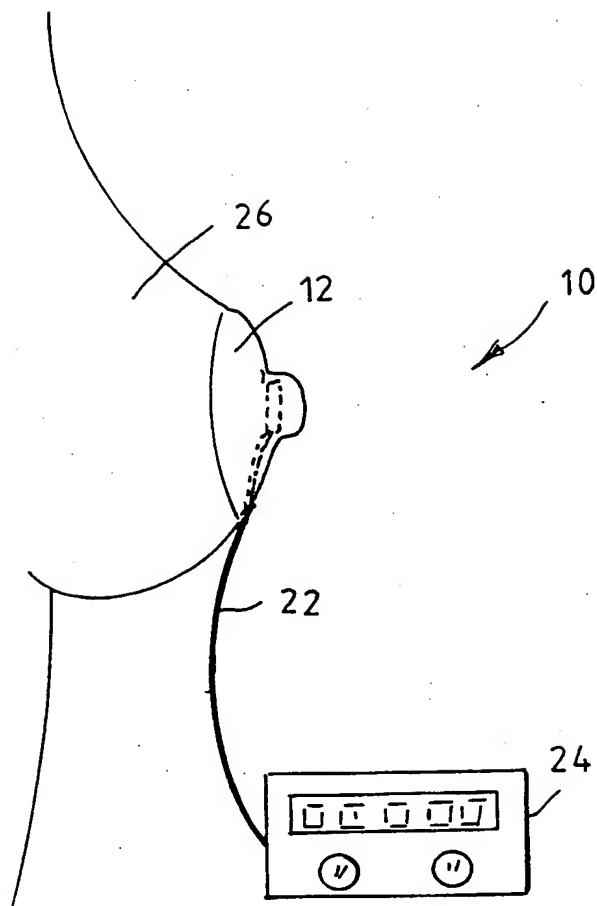


FIGURE 1

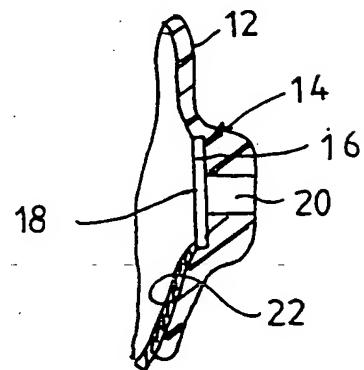
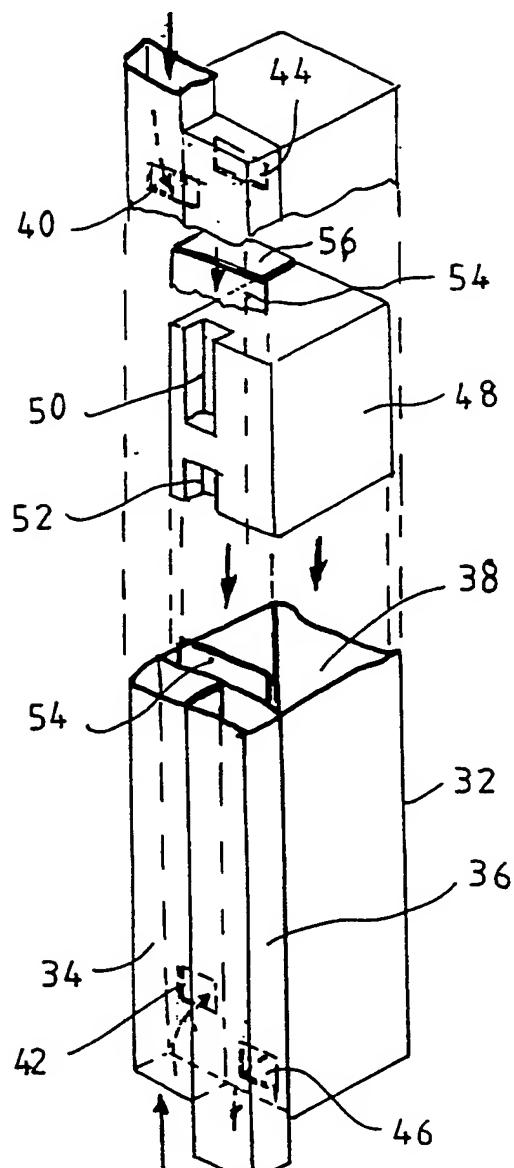
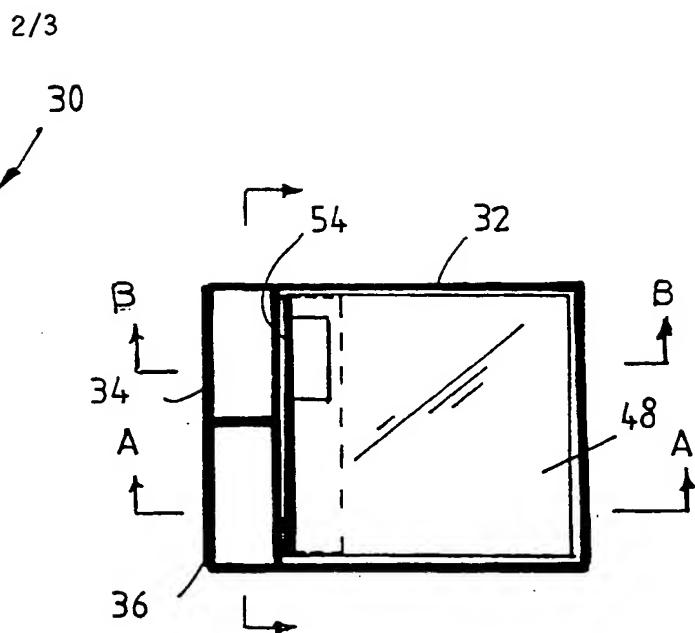
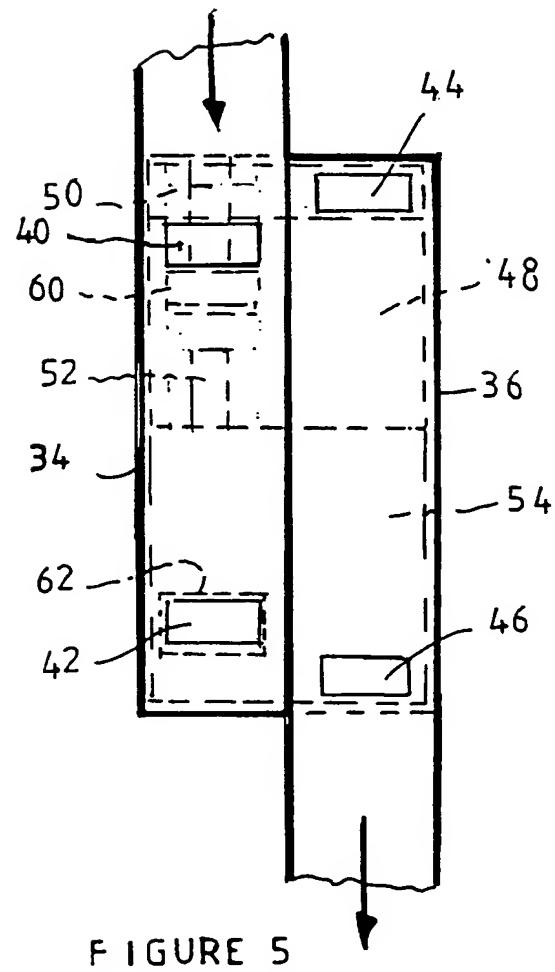


FIGURE 2

FIGURE 3FIGURE 4FIGURE 5

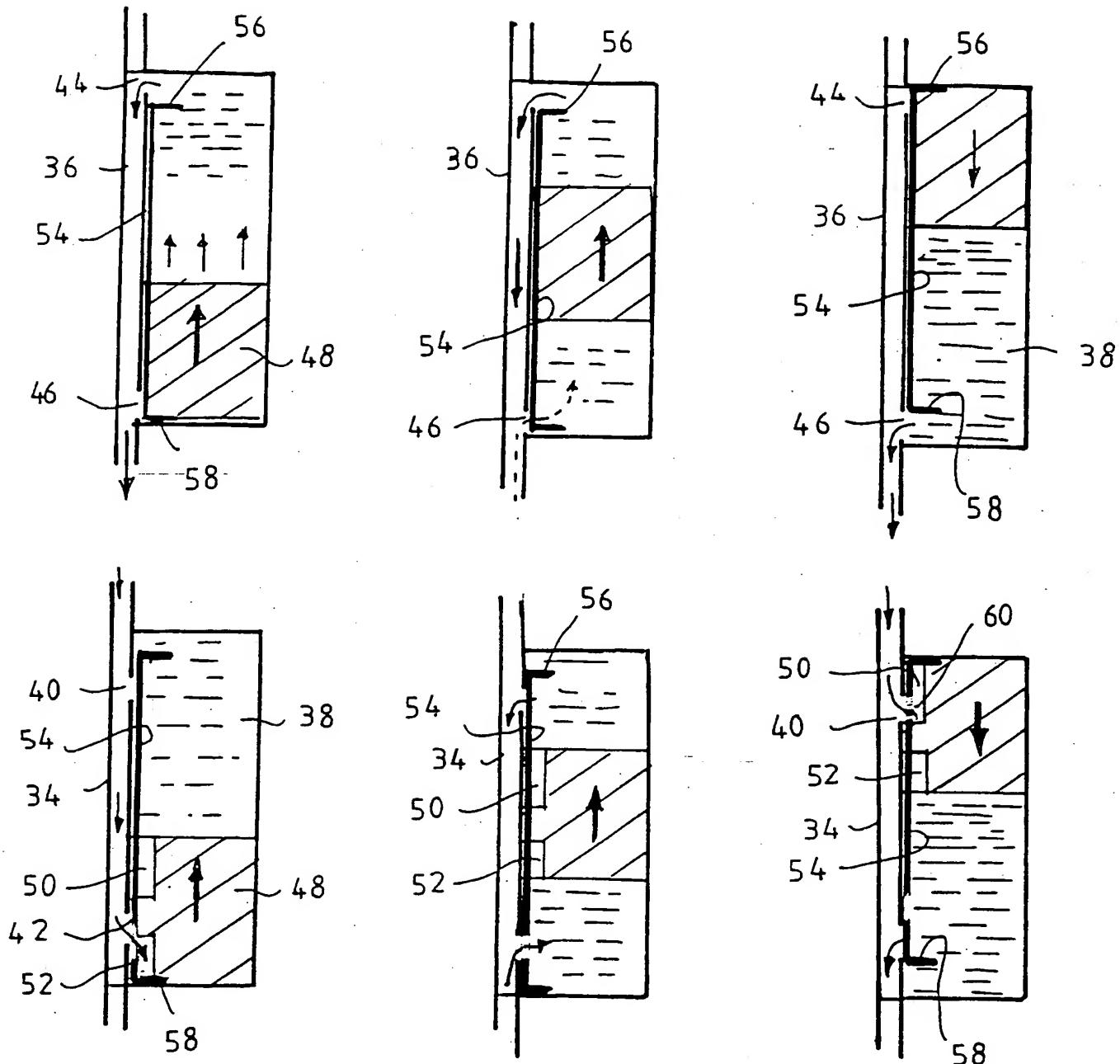


FIGURE 6

## INTERNATIONAL SEARCH REPORT

Inte onal Application No  
PCT/ZA 00/00013A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 A01J5/01 G01F3/16 A61J13/00 A61B5/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 A61B A01J A61J A61M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 827 191 A (ROSENFIELD HAIM) 27 October 1998 (1998-10-27) the whole document, especially: column 1, line 12 - line 25 column 2, line 6 - line 24 column 3, line 5 - line 41 figures 1-4 -----	1-8, 10-12

 Further documents are listed in the continuation of box C. Patent family members are listed in annex.

## \* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
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- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
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Date of the actual completion of the international search

29 September 2000

Date of mailing of the international search report

01.12.2000

Name and mailing address of the ISA  
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## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/ZA 00/00013

### Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.: because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
  
3.  Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

### Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1.  As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
  
2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3.  As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-8,10-12

Remark on Protest

The additional search fees were accompanied by the applicant's protest.

No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-8,10-12

Apparatus for and method of determining the amount of human milk supplied to a feeding baby during a breast feeding session including a flowmeter; a feeding cap therefor

2. Claims: 9,13

A flowmeter with technical characteristics as in Claim 9.

# INTERNATIONAL SEARCH REPORT

## Information on patent family members

International Application No  
PCT/ZA 00/00013

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5827191 A	27-10-1998	NONE	

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